CSc 520

Principles of Programming Languages

48: OO Languages — SmallTalk

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History

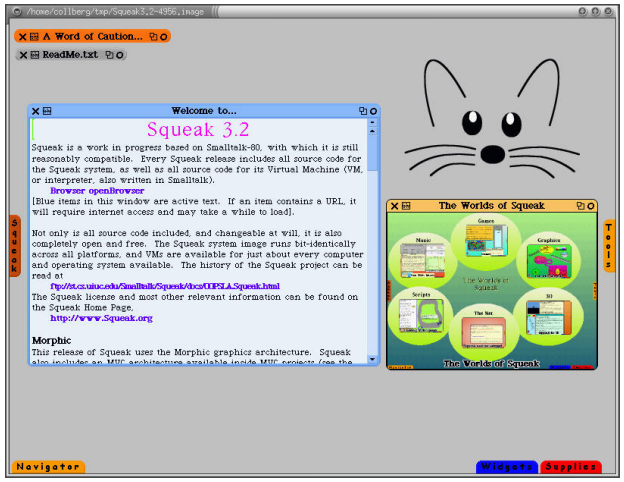
- During the 70's Alan Kay worked on the Dynabook at Xerox Parc. A lot like today's laptops, with integrated touch screen, sound, networking.
- Users would need some sort of programming skills to fully utilize the system. A language for non-experts was needed.
- Smalltalk borrows from Simula, Logo (a language for children), and Sketchpad (a constraint-based interactive drawing system).
- Smalltalk was the first "pure" object-oriented language. Every interaction is through sending a message to an object.

Running Smalltalk

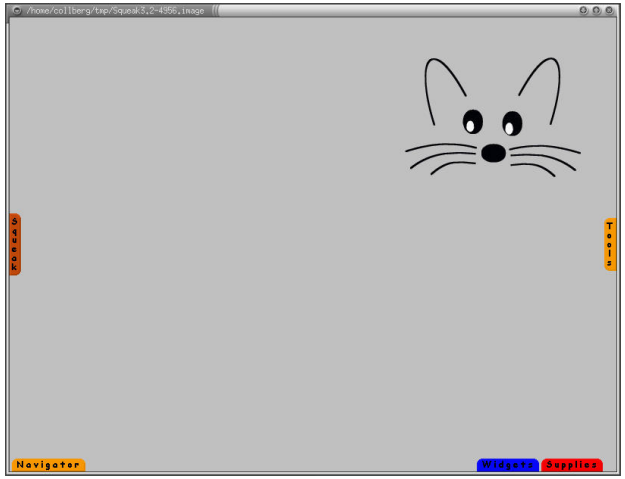
- On lectura, do the following:

```
> cp /usr/local/lib/squeak/3.2-5/Squeak3.2-4956.* .
> setenv SQUEAK_IMAGE $PWD/Squeak3.2-4956.image
> /usr/local/lib/squeak/3.2-5/squeak
```

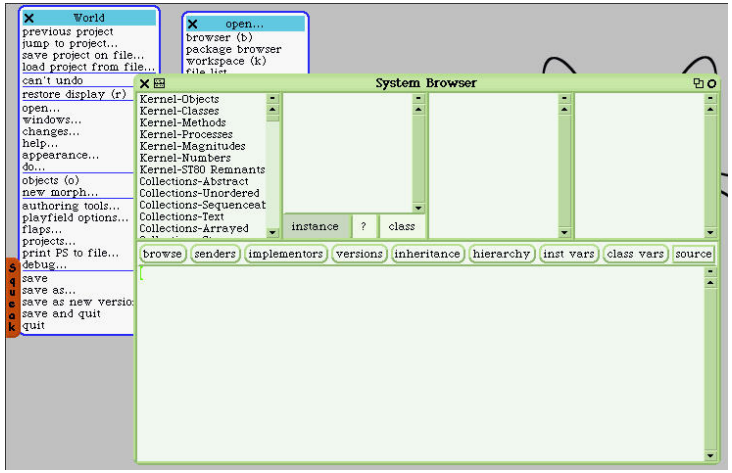

- Squeak's start screen:



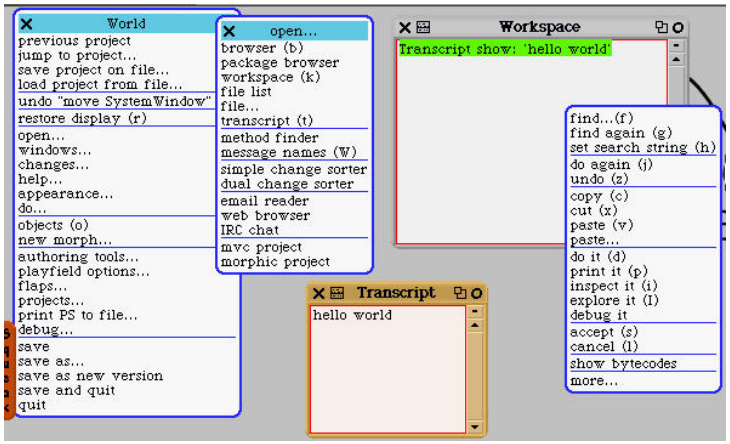
- Get rid of the crud:



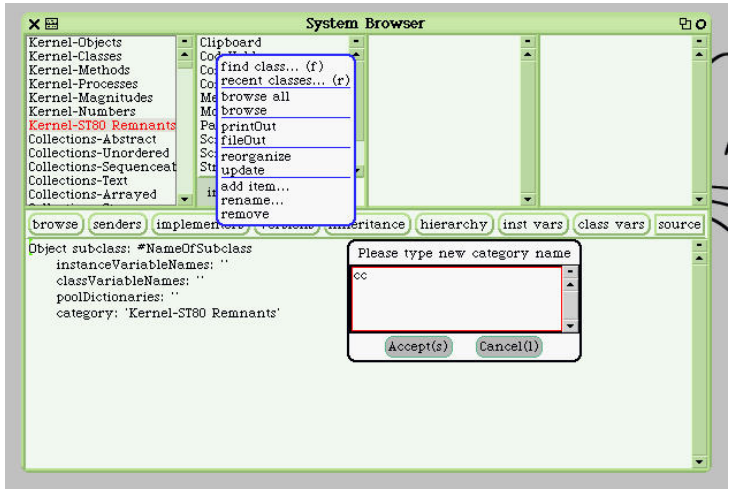
- Open the class browser:



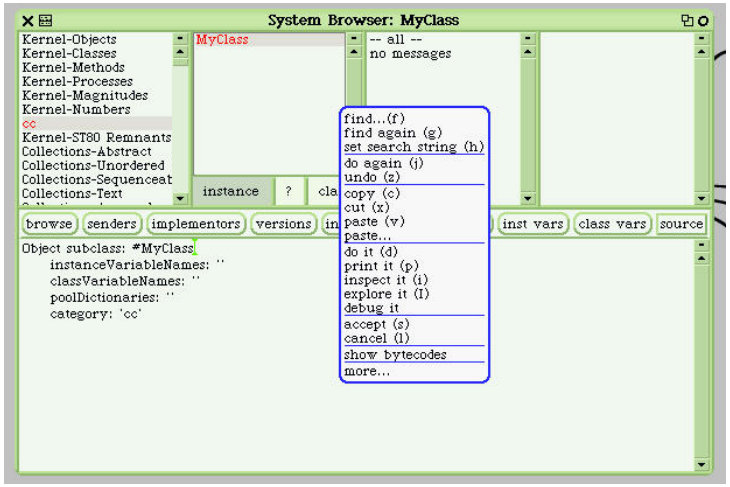
- Workspace lets you enter commands interactively. Transcript is “standard output.” `do it` executes highlighted code.



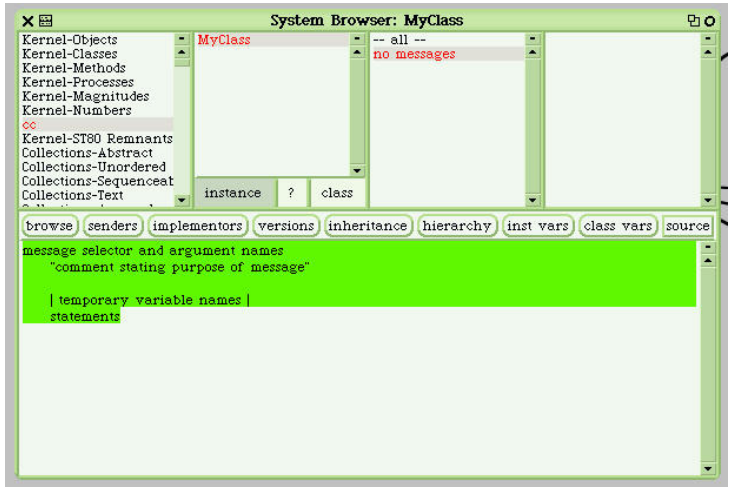
- Create a new category cc.



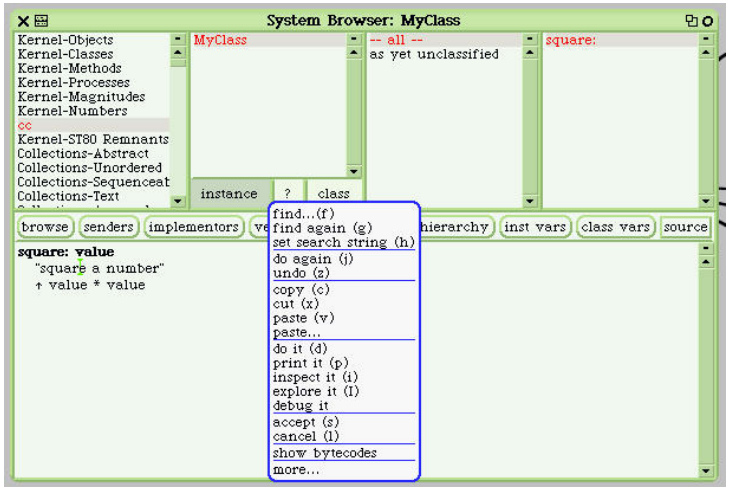
- Create a new class MyClass. Select `accept` to add it.



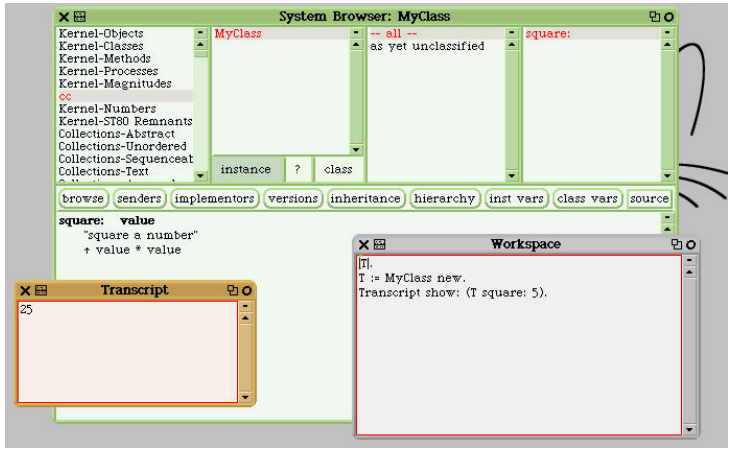
- Click on no messages to get a message template.



- Create a method square. Select `accept` to add it.



- Execute square.



Syntax

- Square brackets `[...]` contain code.
- Global items (variables, classes) begin with a capital letter. Other items start with lowercase.
- Temporary variables: `| x y z |`.
- Assignment: ← or `:=`, or type as _.
- Return value: ↑, type as ^.
- The dot (`.`) is the statement terminator.

Syntax — Unary Messages

- A message M is sent to an object (receiver) R using the syntax

  $R\ \ M$

- A unary message has the syntax

  $R\ \ M$

  For example:

  ```
  D ← Dictionary new.
  ```


Syntax — Binary Messages

- A binary message M to receiver R with argument A has the syntax

  $R\ \ M\ \ A$

- For example:

  ```
  8 + 9
  ```

  This sends the message + to the object 8 with the argument 9.

Syntax — Keyword Messages

- A keyword message M to receiver R with arguments $A_1, A_2, A_3, \ldots$ has the syntax

  $R\ \ M_1\texttt{:}\ \ A_1\ \ M_2\texttt{:}\ \ A_2\ \ M_3\texttt{:}\ \ A_3\ \ \texttt{...}$

- For example:

  ```
  DeannaTroi kiss: cheek how: tenderly
  ```

  This sends the message `kiss:how:` to the object `DeannaTroi` with the arguments `cheek` and `tenderly`. In Java we would have written:

  ```
  DeannaTroi.kisshow(cheek,tenderly)
  ```

Syntax — Order of Evaluation

- Messages are executed from left to right.
- Parentheses can be used to force a particular order of evaluation.
- Expressions are executed in the order
  1. unary messages,
  2. binary messages,
  3. keyword messages
- Binary messages are executed left to right.

Syntax — Cascading messages

- Often we want to send several messages $M_1, M_2, \ldots$ to the same receiver. We can use the syntax

$$R\ \ M_1 : A_1\ .$$
$$R\ \ M_2 : A_2\ .$$
$$R\ \ M_3 : A_3\ .$$

- Or, we can cascade the messages using a semicolon (`;`):

$$R\ \ M_1 : A_1 ;\ \ M_2 : A_2 ;\ \ M_3 : A_3 \ldots$$

- For example:

```
Transcript show:5; cr; show:9; cr.
```


Syntax — Blocks

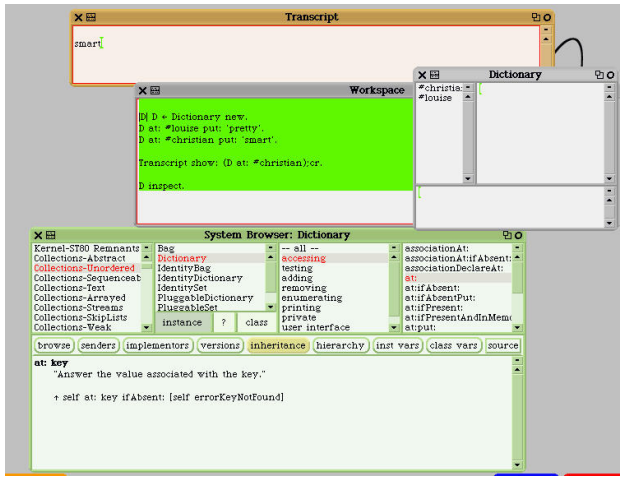
- A block is similar to a lambda expression. It's syntax is:

```
[arguments | code]
```

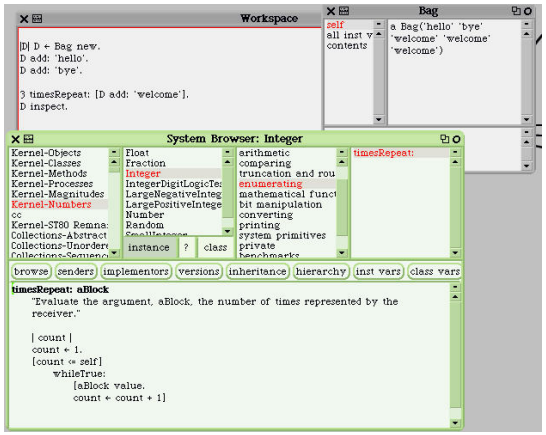
- Arguments are prefixed by a colon (`:`):

```
[:x :y | ↑ x+y ]
```

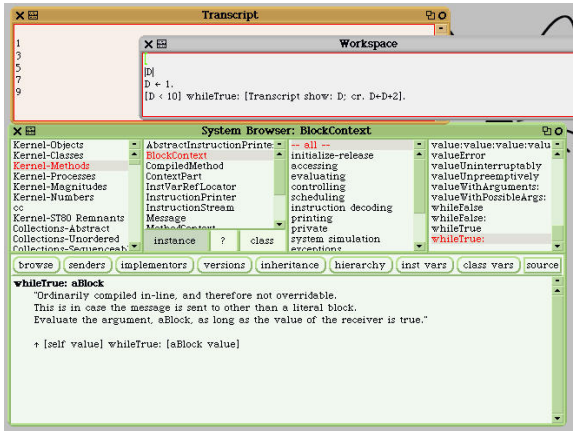

- Collections: Dictionary.



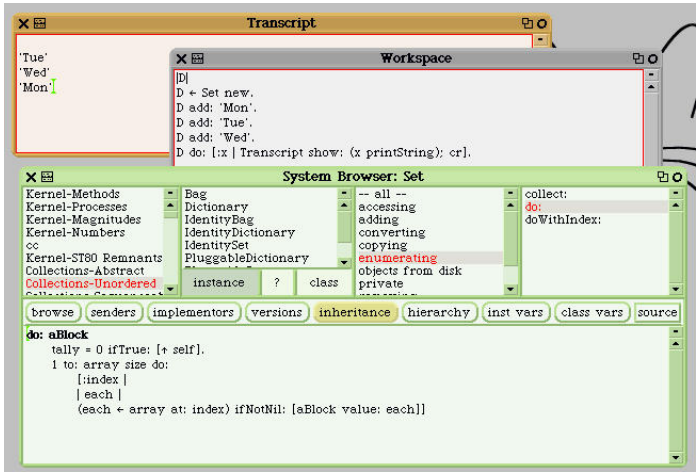
- Collections: Bag. `3 timesRepeat` (from class `Integer`) sends the `value:` message to the block argument 3 times.



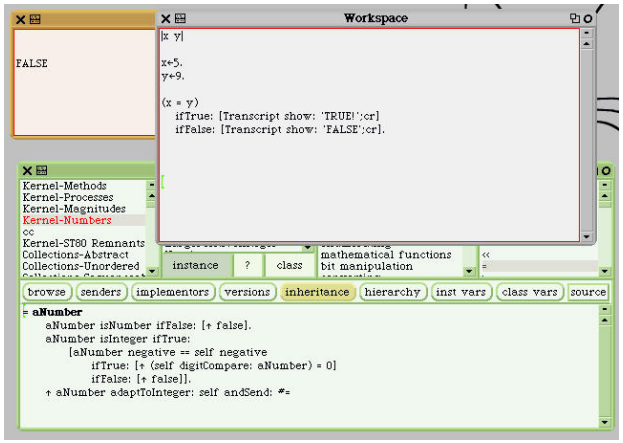
- *expression* `timesRepeat` *block* sends the `value:` message to *block* as long as *expression* is `true`.

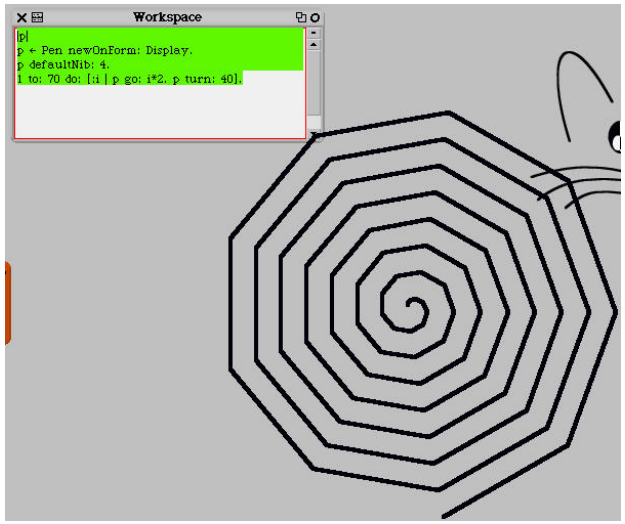


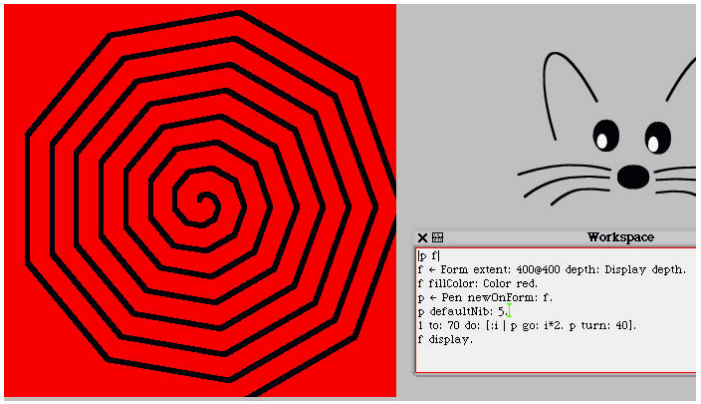
- `do:` `aBlock` enumerates all the receivers elements.



- `ifTrue:ifFalse` evaluates one of its blocks depending on the value of the receiver.







Readings and References

- Squeak download: http://www.squeak.org/download/
- Squeak documentation:
  http://www.squeak.org/documentation/index.html
- Squeak manual:
  http://www.phaidros.com/DIGITALIS/englisch/sqk/sqk00002.htm
- http://www.cosc.canterbury.ac.nz/~wolfgang/cosc205/smalltalk1.html#l
- http://www.cosc.canterbury.ac.nz/~wolfgang/cosc205/labs/labs98.html
- Read Scott: pp. 536,577–580.